Kansas Renewable Energy 2009

Lubrication of Wind Turbines

Donald Brazen

FUCHS LUBRITECH

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Why is Wind Turbine Lubrication so Critical (Demanding)??

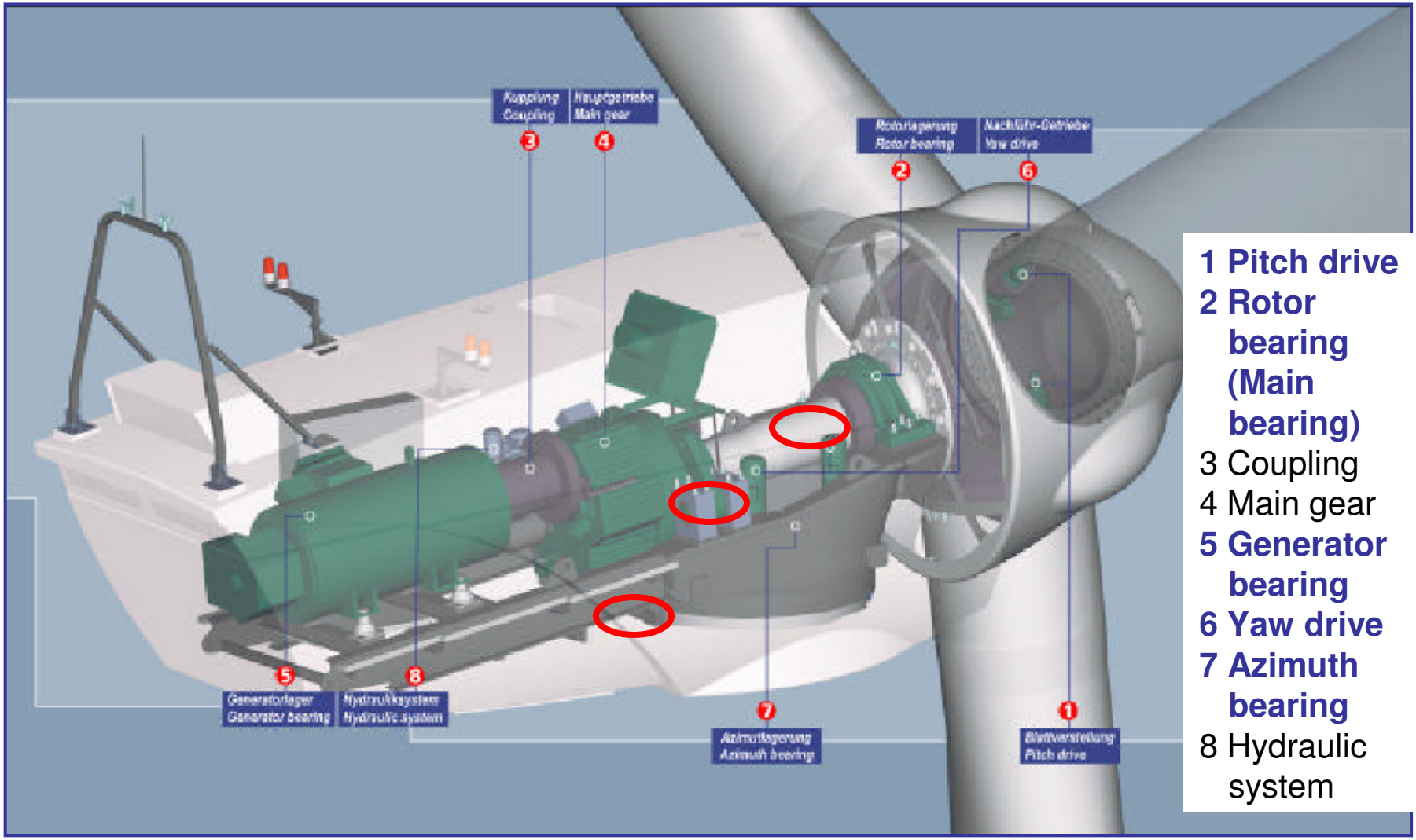
-The lubrication points are 300 feet in the air

-Varying speeds and intermittent usage

-Temperature extremes, especially cold

-Open to the environment (dirt, dust, water)

-High amount of vibration


Kupplung
Coupling
Hauptgetriebe
Main gear
Rotorlagerung
Rotor bearing
Maschinenhaus-Getriebe
Yaw drive
Generatorlager
Generator bearing
Hydrauliksystem
Hydraulic system
Azimutlagerung
Azimuth bearing
Blattverstellung
Pitch drive
1 Pitch drive
2 Rotor bearing (Main bearing)
3 Coupling
4 Main gear
5 Generator bearing
6 Yaw drive
7 Azimuth bearing
8 Hydraulic system

Background:

Application points for Greases in Windpower Plants:

- ⇨ **Pitch Bearings**
- ⇨ **Azimuth/Yaw Bearings**
- ⇨ **Main Bearing (Rotor Bearing)**
- ⇨ **Generator Bearings**
- ⇨ **Gear Teeth of the Azimuth Drive**
- ⇨ **Gear Teeth of the Pitch Drive**

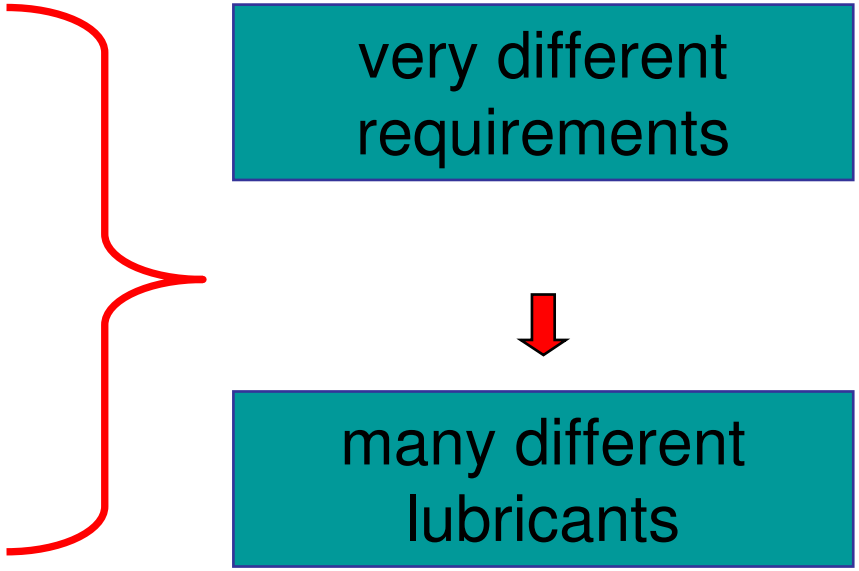
very different requirements

many different lubricants

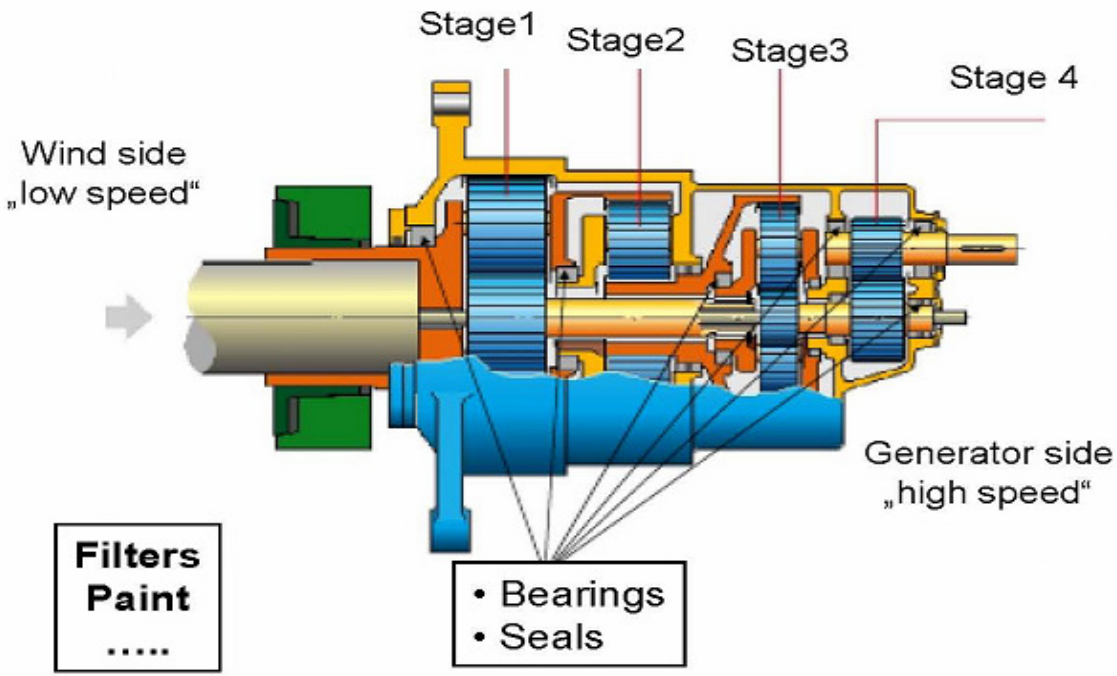
Background:

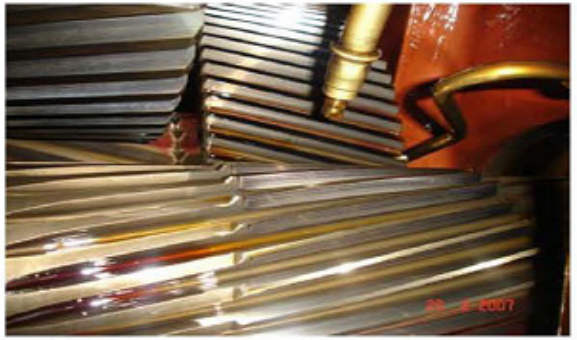
Application points for Oils in Windpower Plants:

- ⇨ **Pitch Gearbox**
- ⇨ **Yaw Gearbox**
- ⇨ **Main Gearbox**
- ⇨ **Hydraulic System**



Gear- Lubricant- Bearing- Seal – Filter- Paint : Windmill





Large-size bearings in wind turbines

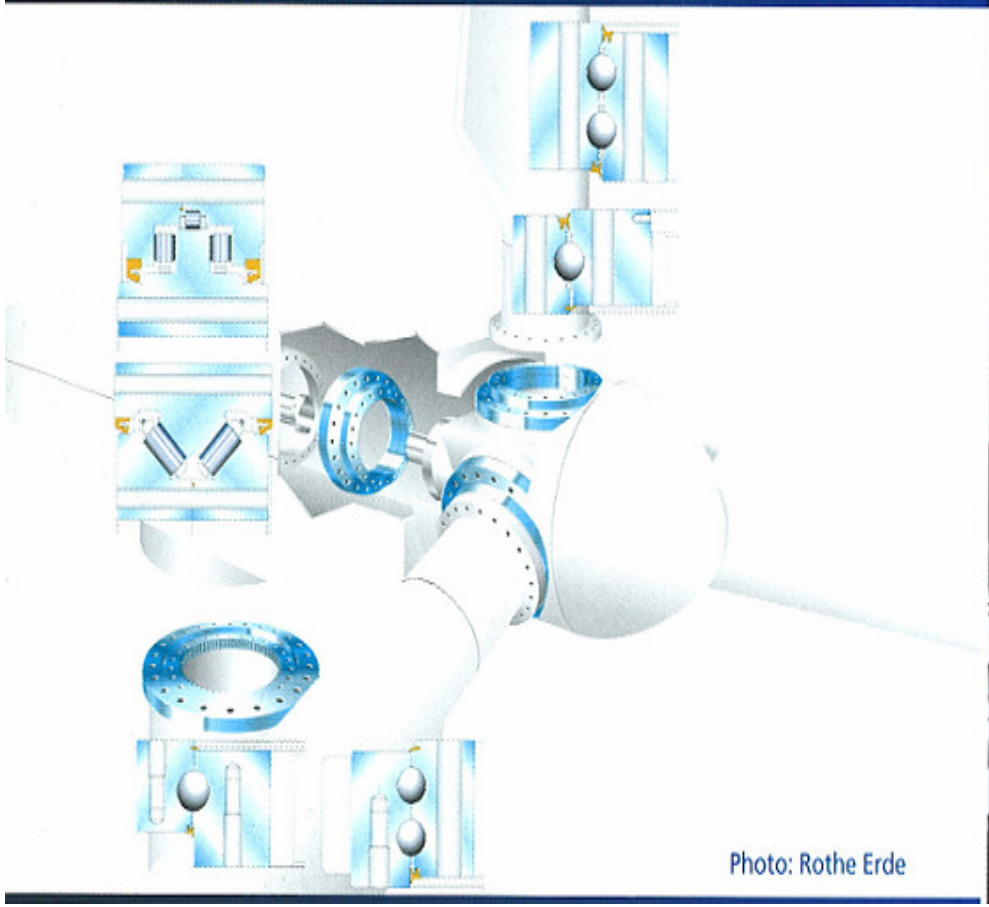


Photo: Rothe Erde

Double row large-size bearings

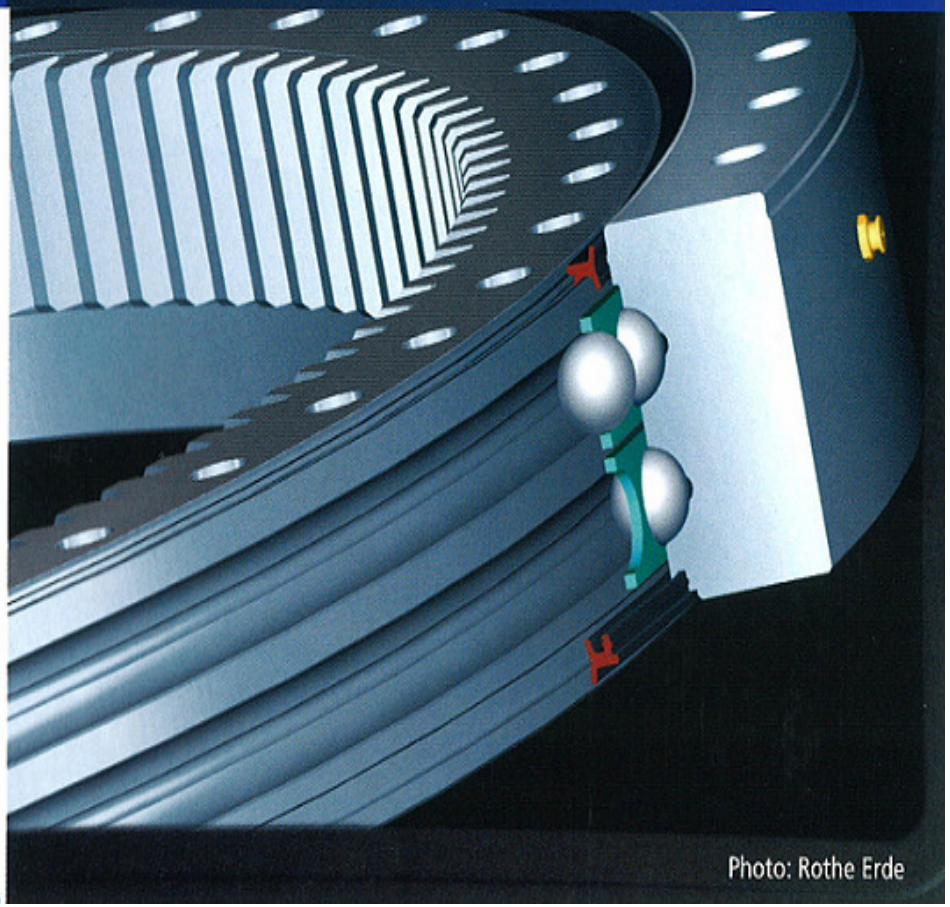


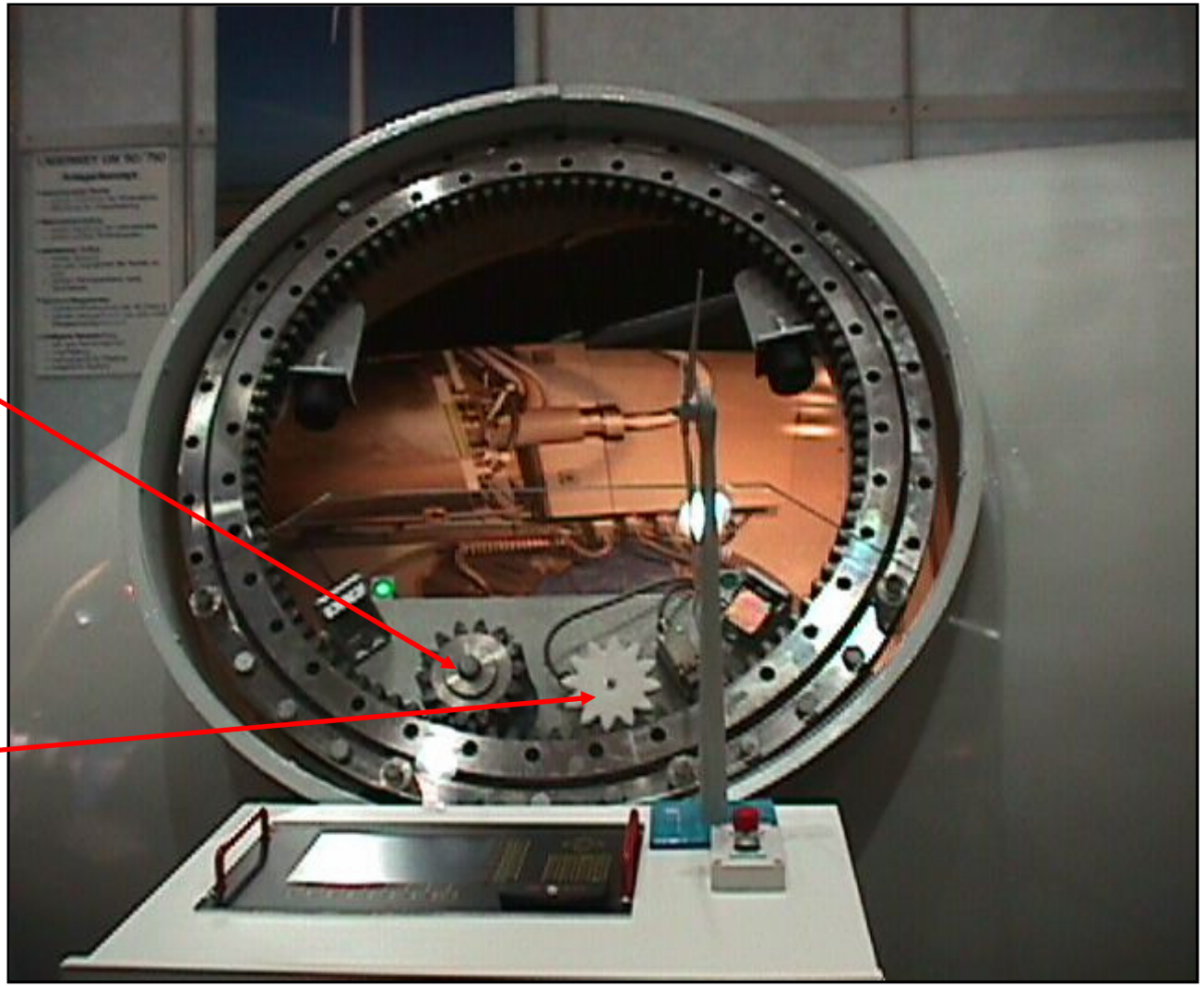
Photo: Rothe Erde

Pitch drive with

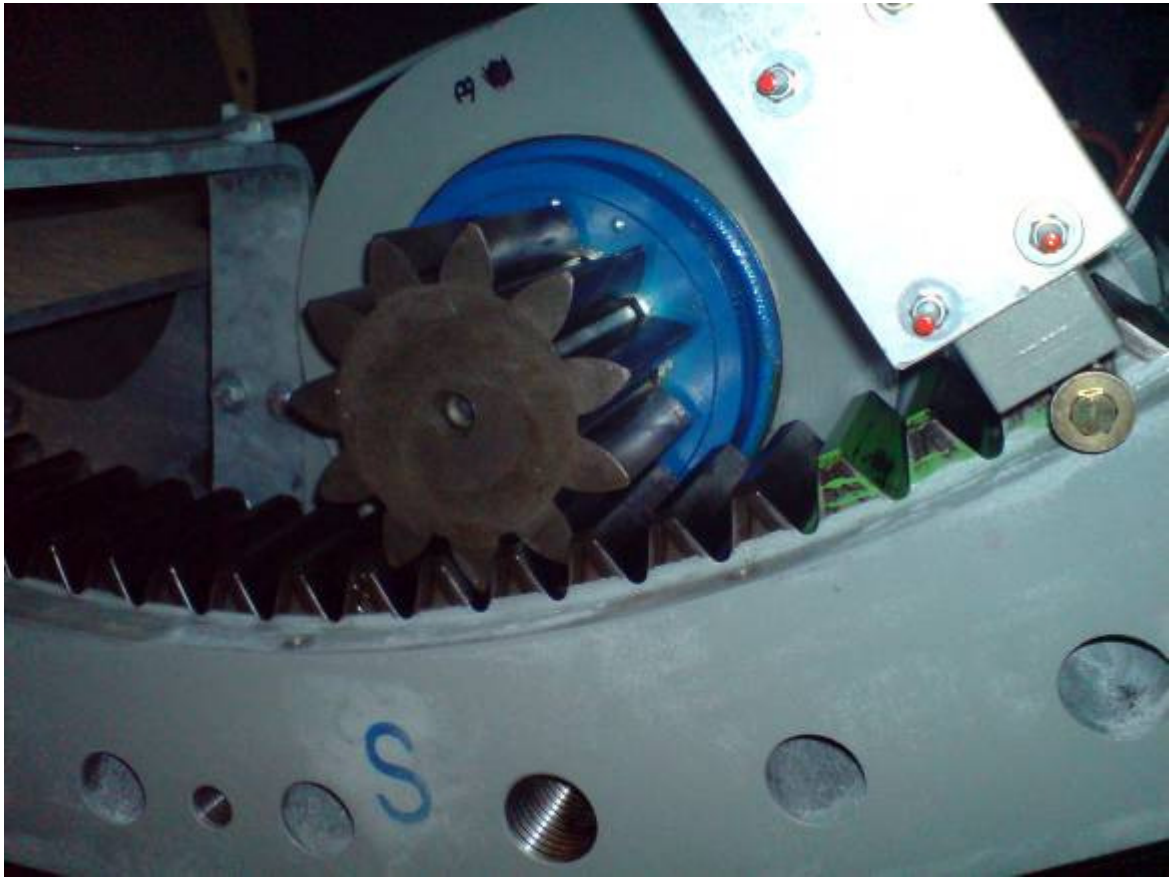
drive pinion

and

lube pinion



Adhesive Lubricant for Gear Teeth



Adhesive Lubricant for Gear Teeth

- Excellent load carrying capacity
- Excellent mechanical stability
- Excellent duration of the lubricating film
- Excellent adhesion even on vertical tooth flanks
- Allows extremely long re-lubrication intervals
- Prevents seizure and wear on tooth flanks
- Outstanding corrosion protection

Automatic Lubricators for Adhesive Lubricant Gear Teeth Applications

Lubricating pinions of different suppliers:

Typical Re-Lubrication Cycles

-Most Grease including Gear Teeth and Slew Bearings– 6 Months

-Hydraulic and Yaw/Pitch Gears Check and top off– 6 Months

-Main Gearbox, if Synthetic, change every 3-5 Years

Over a life of a wind turbine it will use 10 times the amount of lubricant for Maintenance than the original OEM fill

Thus the goal of both Wind Turbine manufacturers and Wind Farm owners is how to lower lubrication costs!!

BUT HOW TO DO THIS??

-**Longer lasting lubricants**
-**Lessen the number of different greases**
-**Use automatic lubricators**
-**Ongoing grease and oil analysis**

Current Situation:

Main Bearing: different anti-friction bearing greases, mostly medium to high base oil viscosity, good EP-properties, high mechanical stability

Pitch and Azimuth Bearing: Special greases for bearings with small adjustment movements, e.g.

Generator Bearing: different anti-friction bearing greases, mostly low to medium base oil viscosity, good suitability for higher speeds, good temperature and oxidation stability

Pitch and Yaw Drive: Adhesive Lubricants, good corrosion protection, high load carrying capacity, long lifetime of the lubricating film, good applicability for example with lube pinions, e.g.

PROBLEM: 4 different grease and 10 different lubrication points make it difficult and expensive to use automatic lubricators

Solution:

One Lubricating Grease with medium base oil viscosity, good EP-properties, good mechanical stability and sufficient load carrying capacity **for the Main Bearing**

One Lubricating Grease with high protection against Ripplings and excellent corrosion protection **for Pitch and Azimuth Bearings**

One Lubricating Grease with good suitability for higher speeds, high ageing resistance and very good temperature resistance **for Generator Bearings**

Result: now we can get down to two greases and make automatic lubricators potentially cost effective and viable.

SUMMARY:

- Wind Turbines require large amounts of high end lubricants

- These applications require regular relubrication

- Over the lifetime of a turbine the lubrication costs can be around $20,000, not counting the labor involved.

- Not all lubricants are alike even if they are on the approve list

- Efforts are being done to help extend lubrication intervals and lower the amount of labor required

- If you are thinking of switching lubricants, make sure you talk to an expert at the OEM or at a lubricant manufacturer

Thank you very much

for your kind attention.